Montana

Forest Insect and Disease Conditions and Program Highlights 1997

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INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 1996 and was jointly prepared by Forest Health Protection, State and Private Forestry, Northern Region, USDA Forest Service and the Montana Department of Natural Resources & Conservation, Forestry Division. Information for this report was derived from ground and aerial surveys conducted across most of Montana.

SUMMARY OF CONDITIONS

Across the State, bark beetle populations have been again in a general decline except for ongoing outbreaks of mountain pine beetle mortality to lodgepole pine in extreme western Montana.

For the third year in a row, no western spruce budworm defoliation was visible from the air in Montana. Low western spruce budworm populations still prevail across most of the western United States. No Douglas-fir tussock moth or pine tussock moth defoliation was observed in 1997.

With the exception of foliage diseases, forest disease populations fluctuate very little compared to forest insect populations. Mortality and growth losses from root diseases and dwarf mistletoes continue to be high throughout the State. Root-disease-caused mortality is more common west of the Continental Divide though large patches can be found east of the Divide.

Dwarf mistletoe continues to cause extensive growth losses and mortality across the State; losses total approximately 33 million cubic feet annually. Douglas-fir west of the Divide, western larch and lodgepole pine are the tree species most severely affected.

White pine blister rust continues to be present throughout the range of five-needle pines in the State. The rust severity is highest in the northwestern part of the State where the disease has caused extensive mortality in white pine and whitebark pine. The rust does occur in limber and whitebark pine on the eastside as well. Disease incidence is relatively low and mortality is uncommon, but may be on a slight increase.

Larch needle cast increased dramatically in 1997 across the host type in western Montana. Lodgepole pine needle cast appears to have reduced to low levels after 5 years of high intensity.

ANNUAL AERIAL SURVEY

The annual aerial survey in Montana was conducted from June 27 to September 23, 1997. The state was surveyed in approximately 250 aircraft flight hours covering approximately 22 million acres of forested land, excluding most wilderness areas.

Much of the data summarized in this report is a product of this aerial survey as well as ground surveys and biological evaluations. Along with the data summaries, aerial survey maps are available from the Forest Health Protection Field Office in Missoula in both paper copies and in digitized GIS format.

The annual aerial survey is an overview survey designed to cover large areas in relative short periods of time. Priority forest disturbances include bark beetle caused mortality, defoliators and windthrow. If forest disturbances activity is low, secondary attributes such as diseases, needle damage and high-water damage are sketch mapped. The survey covers each area once a year during which time the observer sketch maps as many forest disturbances as possible. The survey is conducted using a single-engine, high-wing airplane flying at speeds of approximately 90 to 120 mph, at an average altitude of approximately 1,000 to 2,000 feet (above ground level).

The following table, and subsequent narrative summaries, show infested areas and amounts of associated mortality, as obtained from aerial survey estimates. Though not as many areas were ground checked as we would have liked, enough were checked to lend confidence to the areas for which we only have aerial survey data. Together, aerial and ground surveys provide information relative to bark beetle-caused mortality, as well as damage from other agents, pertinent to land managers charged with the responsibility of maintaining forest health.

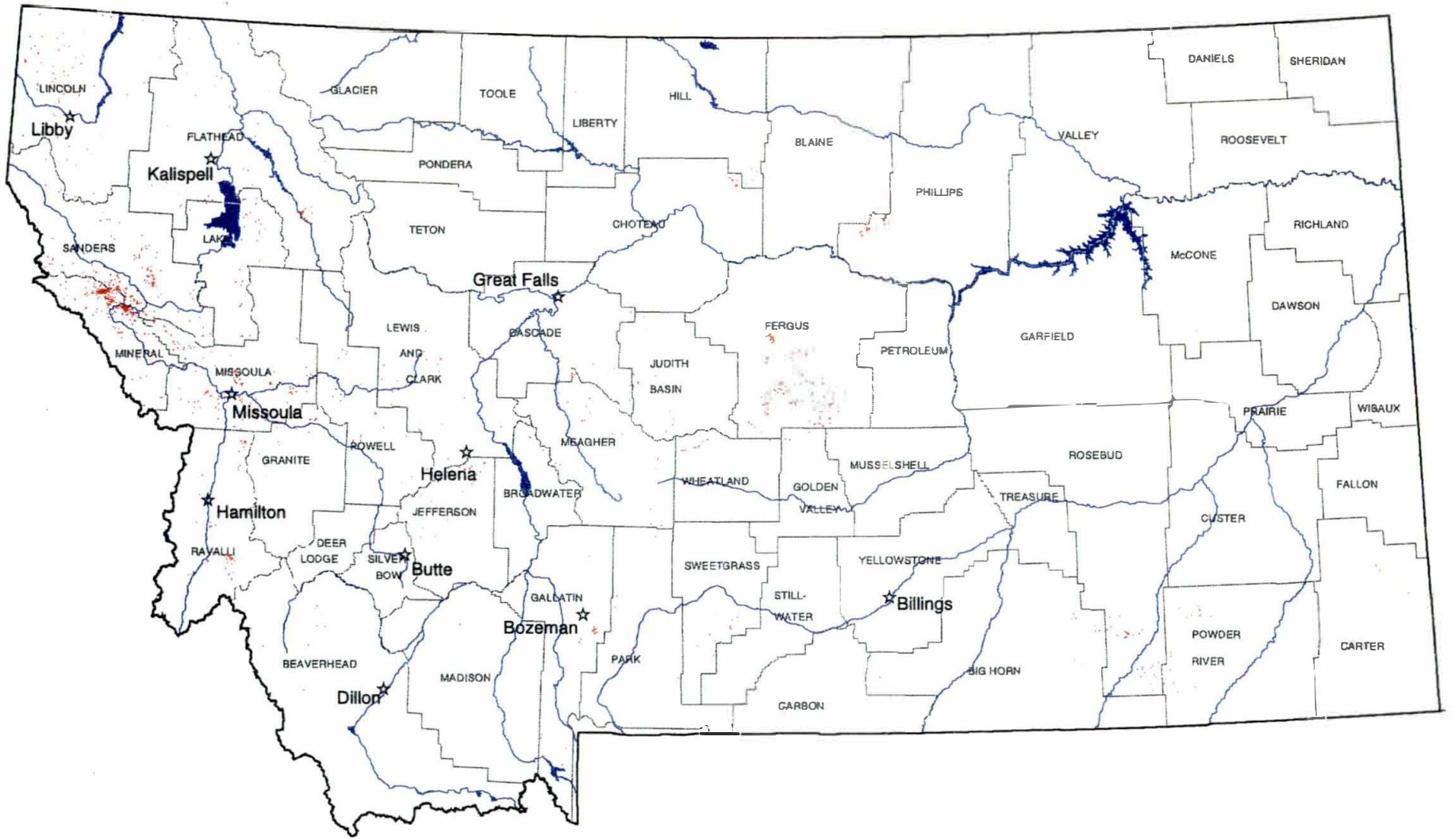


Figure 1.

Areas of mountain pine beetle infestations in Montana (all host species) 1997

Table 1. Bark beetle infested acres, 1994-1997

	1994	1995	1996	1997
DFB*	7,194	5,805	4,353	3,955
ESB	157	767	1,267	1,502
IPS	1,551	8,220	19	513
MPB	19,195	31,340	27,503	34,187
WPB	985	1,433	1,181	857
FEB	318	349	401	615
WBBB	39,292	41,425	44,673	30,088

***The following abbreviations will be used throughout the report:**

Beetles:	DFB	=	Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins
	ESB	=	Spruce beetle, *D. rufipennis* (Kirby)
	IPS	=	Pine engraver, *Ips pini* (Say)
	MPB	=	Mountain pine beelte, *D. ponderosae* Hopkins
	WPB	=	Western pine beetle, *D. brevicomis* LeConte
	FE	=	Fir engraver, *Scolytus ventralis* LeConte
	WBBB	=	Western balsam bark beetle, *Dryocoetes confusus* Swaine
	RTB	=	Red turpentine beetle, *D. valens* LeConte
Hosts:	LPP	=	Lodgepole pine
	PP	=	Ponderosa pine
	WWP	=	Western white pine
	WBP	=	Whitebark pine
	DF	=	Douglas-fir
	GF	=	Grand fir
	SAF	=	Subalpine fir
	ES	=	Engelmann spruce
Other:	NF	=	National Forest
	RD	=	Ranger District
	IR	=	Indian Reservation
	BLM	=	Bureau of Land Management

Reporting area summaries follow. For each, bark beetle effects on their respective hosts are noted. To the extent possible, we have noted areas affected, an estimate of impacts, and population trends. Though reporting areas are designated by Forest names; there are, within those reporting areas, lands under various ownerships--NFS, other Federal, State, and private.

BARK BEETLES

Beaverhead NF

Scattered WBBB-caused mortality was observed in the northern Pioneer Mountains on Wise River RD, as well as in the Beaverhead Mountains on Wisdom RD. No major fader groups were noted elsewhere. A few scattered, small groups of MPB-killed LPP were seen in the northern portion of Pioneers, in Pattengall Creek drainage. Elsewhere, widely scattered groups of DFB-, WBBB-, and MPB-impacted stands were noted on the western portion of the Forest.

A few small groups of WBBB-killed SAF were mapped near Garfield Mountain, within the Tendoy Range. Many large groups of WBBB-caused mortality were observed within the Gravelly Range, from Big Horn Mountain on north to Patch Top Mountain on the south--the most significant ones being west of Monument Hill and near Cascade Mountain.

Only part of the eastern portion of the Beaverhead NF was flown in 1997--for the most part, that piece south of Virginia City, on the Madison RD. Forest-wide, WBBB-caused impacts were the most noticeable. In total, more than 12,000 SAF were killed on just over 6,000 acres.

Bitterroot NF

Widely scattered small groups of MPB-killed PP were mapped both east and west of Highway 93, south of Hamilton, on the Darby RD. Smaller, more scattered groups were observed on private land east of Victor. Elsewhere on the Darby RD, nearly insignificant and widely scattered DF and PP mortality was attributed to DFB and MPB.

South of Missoula, on the Stevensville RD, numerous but mostly small groups of PP killed by MPB were seen on the east slopes of the Sapphire Mountains. The largest group, of about 400 trees, was located on Threemile Wildlife Management Area, managed by the State. A few smaller groups of beetle-killed PP, attributable to MPB, were noted on the west side of the Bitterroot Valley, north of Bass Creek.

Additional groups of MPB-killed PP, some of 50-100 trees each, were mapped over much of the Sula RD and contiguous State and private land. Several of those beetle-killed groups were found on State land near French Basin.

On West Fork RD, small and lightly scattered groups of DF affected by DFB were seen. The biggest concentration was found in the vicinity of Nick Wynn Mountain. Many areas affected by fire or root disease, and which may ultimately be impacted by bark beetles, were mapped in the Selway-Bitterroot and River of No Return Wilderness areas. Except for MPB, no significant bark beetle outbreaks exist on the Forest. Forestwide, more than 4,100 PP were killed by MPB on nearly 2,300 acres.

Custer NF

A few small groups of MPB- or IPS-killed PP were noted in the Ekalaka Hills and a large area of winter-damaged trees were located in the southern portion of the Chalk Buttes. Minor amounts of PP affected by MPB were also mapped in the Long Pines, southeast of Ekalaka. Similar small groups were observed in Slim Buttes as well as south and east of Camp Crook in the West Short Pine Hills and East Short Pine Hills. All of those areas are on lands administered by the Sioux RD.

On the Ashland RD, numerous small groups of 5 PP or less were killed by either MPB or IPS, or a combination of the two. Most of those stands were located on the eastern portion of the District, southeast of Ashland.

West of Red Lodge, on the Beartooth RD, a few small groups MPB-killed LPP and WBP, and WBBB-infested SAF were mapped. Other scattered groups of bark beetle-related mortality were noted in the extreme western portion of the District, south of Big Timber. In the Pryor Mountains, numerous scattered small groups of DF killed by DFB and larger groups of WBBB-caused mortality in SAF were also observed. One group of dead PP extended to about 500 acres and contained a little more than 1 dead tree per acre. Other observed groups were smaller, but still significant. Throughout the Forest, approximately 1,200 acres contained about 2,000 beetle-killed trees.

Deerlodge NF

Little bark beetle activity was noted on the eastern portion of the Forest in 1997. A few

small, scattered groups of MPB-killed LPP, totalling only about 85 acres were observed on the Jefferson RD, for the most part southeast of Whitehall, on the northern end of the Tobacco Root Mountains. Very few fader groups were noticed elsewhere on the Forest. A few DFB-killed DF were observed east of Butte, and a small amount was widely scattered west of Boulder.

On the Phillipsburg RD, only a few widely scattered groups DFB-infested DF, PP and LPP which had been killed by MPB, and WBBB-affected SAF were noted. Most of the MPB activity was mapped along the eastern slopes of the Long John Mountains, and WBBB infestations were noted east of Philipsburg in the Flint Creek Range. Approximately 65 acres showed some level of WBBB activity.

Flathead NF

On the Swan Lake RD, numerous but small and scattered groups of MPB-killed LPP were observed within the Swan Valley. Lesser amounts of MPB-killed WWP and WBBB-caused mortality in SAF stands were noted. Several groups of DFB-killed trees were mapped on the east side of Swan Valley, along Goat Creek, east of Salmon Prairie and north of Condon. Scattered MPB-impacted WBP stands, DFB-killed DF and GF stands affected by FE were mapped along and close to Swan Lake. MPB-caused mortality in LPP was still found on Crane Mountain, but was much reduced from previous years. On the Island Unit, mostly scattered groups of mortality caused by DFB, MPB in LPP and WBBB were also observed. Some MPB-killed PP and WBP were noted in the western portion of the District, as well.

LPP stands infested by MPB are becoming more numerous and widespread on the Spotted Bear RD. Many groups of beetle-killed trees were found along the South Fork Flathead River. One group near Spotted Bear Lake numbered 500 trees and contained numerous trees attacked in 1997. Permanent population trend plots, located southeast of the Ranger Station, which were established in 1979, finally began showing some small amount of beetle activity. Also on the District, DFB-caused mortality was reduced, but SAF killed by WBBB was more noticeable. Several small groups of ES killed by ESB were mapped in the eastern portion of the Swan Range, from Brinker Creek north to Hungry Horse RD boundary.

On the Hungry Horse RD, widely scattered groups of bark beetle-caused mortality were noted throughout the District. MPB-infested WWP was concentrated along Hungry Horse Reservoir. Much of that mortality is associated with white pine blister rust (WPBR), which is also prevalent there. Similar infestations were also noted north of Echo Lake. Groups of DF affected by DFB were more numerous in the northern portion of the District--especially on Coram Experimental Forest and in the northern portion of the Swan Range, north of Lake Blaine. Other beetle occurrences were widely scattered, and mostly small, yet numerous. Mortality attributed to DFB, ESB, MPB and WBBB was recorded.

On the Tally Lake RD, DFB activity continued east of Tally Lake. That infestation, though not extensive, has been active for several years. WBBB-caused mortality became more extensive on the western portion of the District, especially near Ashley and Sheppard Mountains. Elsewhere, lightly scattered DFB- and WBBB-killed trees were observed. Numerous stands of DF, currently infested by DFB, were found within the area of the Little Wolf Fire. Those populations have built in down and fire-weakened trees over the past three years. Also within the area affected by the 1994 burn, ESB "control" efforts--using a combination of pheromone-baited funnel traps, trap trees and salvage--were very successful in reducing beetle populations to near endemic levels.

Within the North Fork Flathead River drainage, on the Glacier View RD, the most prevalent occurrence of bark beetle-caused mortality was attributed to WBBB. Many groups of 50 trees or less were found scattered throughout SAF timber types. Significant groups of up to 500 trees each were recorded in the Hay Creek drainage. Elsewhere, small and widely scattered groups of trees killed by ESB, DFB, MPB--in both WWP and LPP--were observed. A substantial amount of recent winter damage, and effects of WPBR were also noted throughout the District.

Forest-wide, mortality attributed to bark beetles totalled the following amounts: DFB--1,260 DF on 530 acres; ESB--850 ES on 540 acres; MPB-

-nearly 2,400 trees of all host species on 1,330 acres; and WBBB--almost 2,200 SAF on 775 acres. Though significant in some stands, mortality is much reduced from just a few years ago.

Gallatin NF

Within the Crazy Mountains, on both the Big Timber and Livingston RDs, small and widely scattered groups MPB-killed LPP and WBBB-infested SAF were observed. Also noted throughout the Range were numerous areas of winter damaged trees and as yet unidentified damage occurring in WBP. Though that area was not ground-checked, similar-appearing damage in other parts of the Region has been attributed to combinations of WPBR, MPB, winter damage, and general decline. Some of those areas were especially noticeable in the northern portion of the Crazy Mountains which adjoins the Lewis and Clark NF. Elsewhere on the Big Timber RD, WBBB-caused mortality and a relatively minor amount of DFB-killed DF were mapped within the Boulder River corridor. Small amounts of MPB-caused mortality in LPP and ES killed by ESB were found there as well. South of Big Timber, in both the Upper and Lower Deer Creek drainages, scattered DFB-killed trees and PP mortality attributed to MPB were mapped. Most of those fader groups are small and well dispersed.

On the Bozeman RD, nearly insignificant amounts of MPB-killed LPP and WBBB-killed SAF were found widely scattered in the Bridger Mountains. Elsewhere on the District, south toward and onto the Hebgen Lake RD, within the Madison and Gallatin mountain ranges, many large groups of SAF infested by WBBB were found. Those infested stands increased significantly in the past year. Within the reporting area, more than 41,900 SAF were killed on just over 21,300 acres. Other scattered bark beetle-caused mortality--MPB in LPP and WBP, DFB, and ESB--was insignificant in comparison.

On the Gardiner RD, some groups of SAF killed by WBBB and WBP infested by MPB were also noted near Cooke City and northeast of Gardiner. Small amounts of scattered DFB-killed groups of DF were mapped near Jardine.

Helena NF

On the Lincoln RD, many small groups of DFB-infested stands were observed west and south of Lincoln. Though numerous groups of faders were mapped during aerial surveys, ground surveys showed that little of the once-active outbreak in that area remains. In that same portion of the District, significant amounts of MPB-killed PP was mapped; and in the vicinity of the Ranger Station, numerous new attacks were found in 1997. North of Lincoln, scattered WBBB-caused mortality was noted. Some significant concentrations of that mortality were seen in the Copper Creek drainage. On the eastern portion of the District, scattered MPB-killed LPP and PP were observed.

South and west of Helena, on the Helena RD, scattered small groups of PP killed by MPB were mapped. Some WPB-caused mortality in PP was also mapped, but that far east the damaging agent was probably MPB. WPB populations have never been confirmed east of the Continental Divide. Numerous scattered groups of MPB-killed PP were also found south and east of Helena, however, most were 5-tree groups or smaller. Ground surveys conducted in that area showed few currently infested trees. Extensive areas of winter damage were noted from Lava Mountain south to Prickly Pear Creek, and could predispose those stands to additional bark beetle-caused mortality.

On the Townsend RD, east of Canyon Ferry Reservoir, in the Big Belt Mountains, widely scattered small groups of MPB-killed LPP and SAF infested by WBBB were observed. Small concentrations of DFB-caused mortality were also noted north and east of Middleman Mountain. In North Fork Deep Creek drainage, several groups of MPB-killed WBP, ranging from 2-15 trees each, were observed.

Forest-wide, DFB killed 650 trees on about 270 acres, while almost 1400 trees, mostly PP, were killed by MPB. Other beetle-caused mortality was virtually insignificant.

Kootenai NF

No major bark beetle outbreaks existed on the Forest in 1997. Unlike only a decade or so ago, when MPB infested over 400,000 acres on the

Kootenai alone, last year MPB-caused mortality was found on only 1,280 acres. Total mortality, in all host species, amounted to only 3,500 trees. Other bark beetle-related mortality accumulated to 770 trees killed by DFB on 400 acres; and lesser amounts of ESB-, WBBB- and WPB-caused tree death in their respective hosts.
On the Three Rivers RD, many scattered, but mostly small groups of MPB-caused faders in WWP and LPP stands were observed in the upper Yaak River drainage. One large group of 2000 trees was observed near Newton Mountain. Additional small groups of MPB-killed LPP were noted along South Fork Yaak River. Numerous, but mostly small groups of DF, killed by DFB, were seen in Lynx Creek drainage, northeast of Troy and near Yaak Mountain.

On the Libby/Canoe Gulch RD, widely scattered and numerous groups of WWP, LPP and PP, which had been killed by MPB, were mapped both north and south of Libby. Isolated clusters of ES and GF, killed by ESB and FE, respectively, were noted northeast of Libby in the Rice Creek and Doak Creek drainages. Numerous groups of MPB-killed LPP and WWP, as well as GF, killed by FE, were observed in Libby and Bear Creek drainages, south of Libby. At higher elevations, small amounts of WBBB-infested SAF were noted.

Many small groups of MPB-killed WWP were observed in the South Fork Big Creek on the Rexford RD. Elsewhere, beetle-killed groups were widely scattered. Small, generally isolated groups of DF, ES, and SAF were affected by DFB, ESB and WBBB, respectively, throughout the District. A small concentration of DFB-affected trees was seen west of Independence Peak, north of Rexford.

No major bark beetle outbreaks were found on the Fortine RD; however, a few small groups of WBBB-killed SAF were noted in the Grave Creek drainage and near Therriault Lakes. A small number of DF, infested by DFB, were recorded within the Deep Creek drainage north of Murphy Lake. A more significant group of LPP faders, totalling 200 trees and killed by MPB, were mapped near Laughing Water Creek, north of Martin Lake.

On the Cabinet RD, numerous, widely scattered groups of DFB- and FE-affected stands were noted throughout the District. The highest concentrations of that mortality were found in Little Beaver and Big Beaver Creek drainages, and above White Pine Creek. Other beetle-caused mortality was more scattered and often found in association with root diseases which are widespread on the District.

Lewis and Clark

In the Judith Mountains, on BLM-administered lands northeast of Lewistown, numerous scattered groups of MPB-infested PP were found. Though the largest group was of only 50 trees, many were of 5-20 trees each. Northwest of there, in the Moccasin Mountains, many groups of 10-60 beetle-killed trees were seen. One group numbered an estimated 200 trees. A similar situation existed in the South Moccasin Mountains. Many scattered groups of PP, also killed by MPB, were noted in both the Big and Little Snowy Mountains, south and east of Lewistown. Many were on BLM or private land; however, some of those outbreaks were on the Judith and Musselshell RDs. Most were small, 2-10 tree groups. Several areas in the Highwood Mountains, on the Judith RD, contained small clusters of faders--LPP which had been killed by MPB or DF which had been infested by DFB.

In the Big Snowy Mountains and the Highwood Mountains, large areas of winter-damaged trees were noted. As in past outbreaks, such damage could result in trees becoming more susceptible to future bark beetle depredations.

In the Castle Mountains, Kings Hill RD, and near Whetstone Ridge, Musselshell RD, a few small groups of MPB-killed PP, and lesser amount of LPP, were found. In the Little Belt Mountains, on the Kings Hill RD, a few widely scattered groups of beetle-killed trees--MPB in PP and LPP, DFB and WBBB in their respective hosts--were seen. A few more were noted on the southern portion of the Musselshell RD. Throughout the area, large expanses of winter-damaged trees--particularly in the northern part of the District, from about Ming Coulee eastward to Spring Coulee--were recorded. The Rocky Mountain RD was not flown. Throughout the Forest, most of the beetle-caused mortality was attributable to MPB affecting PP stands. More than 4,000 trees were killed on about 3,300 acres.

Lolo NF

On the Missoula RD, numerous but mostly small groups of DFB-killed trees were observed throughout Rock Creek drainage and associated drainages east of Missoula and south of Interstate 90. A few other beetle-killed groups were noted in that area, caused by WPB, MPB--in both PP and LPP, and IPS in PP, but were generally of less importance. South and east of Missoula, in the Miller and Pattee Creek drainages, many small groups of PP, killed by both MPB and WPB, were mapped. A few small groups of LPP, killed by MPB, were noted above Allen Creek, west of Clinton. North and east of Missoula, in Rattlesnake, Grant, Butler, and Lavalle Creek drainages, numerous scattered groups of MPB- and WPB-killed PP were observed. Additional concentrations of MPB-killed PP were found near the mouth of Gold Creek, east of Bonner. Several similar groups were also noted west of Missoula near Blue Mountain, in the O'Brien Creek drainage, and in a scattered pattern within the Lolo Creek drainage.

Numerous groups of DFB-killed trees were observed throughout the Swan Range, from about Morrell Mountain to Kleinschmidt Flat, on the Seeley Lake RD. Highest concentrations were seen above Cottonwood Creek, southeast of Morrell Lookout and north of Doney Lake. Others were more scattered. A few small groups of FE- and WBBB-caused mortality were also recorded.

Within the Garnet Mountain Range, on lands administered for the most part by BLM, many small and widely scattered groups of PP, killed by MPB, were mapped. Many were concentrated on the Lubrecht State Experimental Forest, east of Potomac; but many others were located south and east of Bonner and in the southern portion of the Range, along the Interstate 90 corridor. Several groups were particularly noticeable near Cramer Creek, Little Bear Creek, in the Tenmile Creek drainage and near Mulkey Gulch. Other groups were noted in the eastern part of the reporting area near Hoover Creek, Gough Gulch and close to Nevada Lake. Still others were concentrated near McElwain Creek, Evans Lake and Clearwater Junction. Elsewhere in the reporting area, small and widely scattered groups of DFB-, WBBB-, and WPB-killed trees were observed, but were generally of little consequence.

On the Ninemile RD, many groups of MPB-killed PP were noted in the lower portion of the Ninemile Valley. Many of those were on private land. In the upper part of the drainage, numerous groups of LPP had been killed by MPB. Several large groups of beetle-killed LPP, some up to 200 trees each, were mapped near Siegel Pass. Ground surveys there did not reveal a particularly active infestation. Elsewhere on the District, MPB-killed trees were more scattered. A few, widely dispersed MPB-killed groups of trees--combinations of PP, LPP, and WWP--were observed throughout the Fish Creek drainage. Also recorded there were minor amounts of DFB- and WBBB-caused mortality.

The largest MPB outbreak currently existing in the Region was mapped within LPP stands on the Superior RD. Large groups of beetle-killed trees, of up to 20,000 trees each, were recorded in upper Sloway Gulch and near Keystone Peak. Those groups are still very active. Ground surveys conducted there showed 1997 attacks averaging nearly 100 per acre. Smaller groups were scattered throughout LPP stands from West Fall Creek to the Clark Fork River. Another major infestation occurred west of the Clark Fork River, in the Tamarack Creek drainage. Some of those groups were as large as 80,000 trees each. Infestations decreased towards Twelvemile Creek, but infested groups were still numerous and active. Mortality became more scattered south of Clark Fork and St. Regis Rivers, but was still noticeable. Most of the LPP stands infested by MPB on the Forest were found on the District. More than 14,700 acres were infested and nearly 27,000 trees were killed. Close to the Clark Fork River, and at lower elevations, PP was also killed by MPB. Widely scattered, but much less significant mortality attributable to other beetles--DFB, WPB, and WBBB--was also observed.

On the Plains/Thompson Falls RD, MPB outbreaks in LPP appeared to be building all along CC Divide. Fader groups were located throughout the Coeur d'Alene Mountains from the Clark Fork/Flathead River confluence, west to Cherry Creek. Many of those infested stands, including one 6,000-tree group, were in the upper Swamp Creek drainage. MPB-infested

LPP stands became more numerous within the Prospect Creek drainage, north of Plains in the Thompson River and McGinnis Creek drainages, and from there eastward towards Reservation Divide. In the western part of the Thompson Falls RD, other bark beetle-killed trees were numerous. Depredations attributed to FE, DFB, MPB in WWP were common, and often associated with root diseases which are prevalent in that area.

In addition to the significant MPB-caused mortality previously noted on the Superior RD, elsewhere Forest-wide, bark beetles killed 2,000 DF on 1,100 acres; 4,200 PP on 3,000 acres; and 350 SAF on almost 200 acres.

Crow IR

Several groups of MPB-infested PP were observed along Pryor Creek, in the northern portion of the Pryor Mountains. Some minor amounts of LPP killed by MPB were also noted in that range. Though the remainder of the Reservation was not flown in 1997, we believe no major bark beetle-caused mortality existed there.

Northern Cheyenne IR

Scattered, mostly small groups of PP, killed by combinations of MPB and IPS, were mapped south and east of Lame Deer. Much of that mortality is closely related to the effects of continual thinning and burning. One MPB-killed group, north of Station Spring contained 100 faders. Most other groups were of 20 trees or less. Several groups of dead trees, one of 200 trees, was mapped in the northwest section of the Reservation, in the Sarpy Mountains. In total, just over 1,000 trees were killed on nearly 650 acres.

Flathead IR

Many small groups of DFB-caused mortality was found along the west slopes of Mission Mountains from St. Marys Lake north to North Crow Creek. At lower elevations, also in the Mission Range, widely scattered groups of MPB-killed PP and occasionally larger groups of MPB-killed LPP were recorded. One of those groups, seen near Swartz Lake, contained 200 faders. Numerous small groups of LPP, killed by MPB, were also noted along the western slopes of the Missions, from Boulder Creek to Yellow Bay Creek. In that same general area, minor amounts for FE- and WPB-caused mortality was also recorded. PP killed by MPB were frequently found along the Jocko River, especially in the area of Pistol Creek. Additional MPB-infested PP stands were found in the southern portion of Reservation, from Evaro north and west to Perma.

Some MPB-impacted stands of LPP were noted in Hewolf Creek, and were also prevalent around Rainbow Lake and Hot Springs. One of the more significant groups, south of Rainbow Lake, numbered 2000 beetle-killed trees. Elsewhere, PP killed by both MPB and WPB were found widely scattered throughout the PP type. Throughout the Reservation, the most important beetle outbreaks were WPB, DFB and MPB, in that order. WPB was recorded on 104 acres and killed 64 trees. DFB was found on 163 acres, killing 317 DF. And MPB killed more than 5,000 trees (4,500 of them LPP) on about 1,100 acres.

Glacier National Park

Only the western portion of the Park was flown in 1997. In that area, small groups of DFB-infested DF were observed along Kintla, Upper Kintla, Bowman, Quartz and Logging Lakes. No groups were larger than about 10 trees each, and though they are more numerous than ones recorded there in 1996, infestations do not appear to be building rapidly. In total, only about 360 trees were killed on approximately 140 acres. Numerous groups of ESB-killed ES were mapped along Camas Creek, Dutch Creek and McDonald Creek. Those infestations totalled about 700 trees on close to 350 acres. Elsewhere in the area flown, only widely scattered, small amounts of MPB-caused mortality in LPP and WBP were observed.

Yellowstone National Park

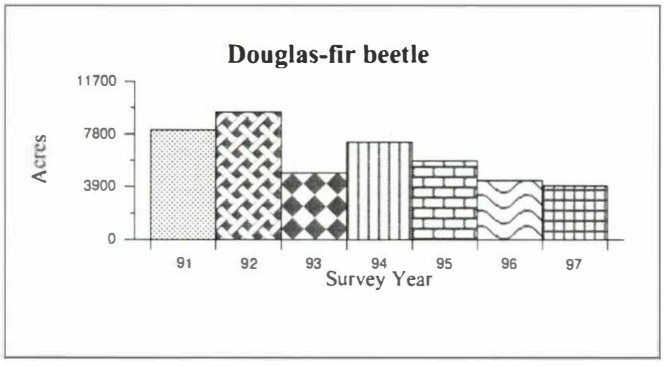
In the northeast corner of the Park, many groups of ESB-killed ES, DFB-infested DF, and WBBB-impacted SAF were observed. In the case of those ESB- and DF-affected stands, beetle populations are remnants of those which built up following the fires in 1988 and the ensuing several years of drier-than-normal weather. They are gradually returning to endemic levels. SAF stands, infested with WBBB, on the other hand, appear to be suffering increasing decline,

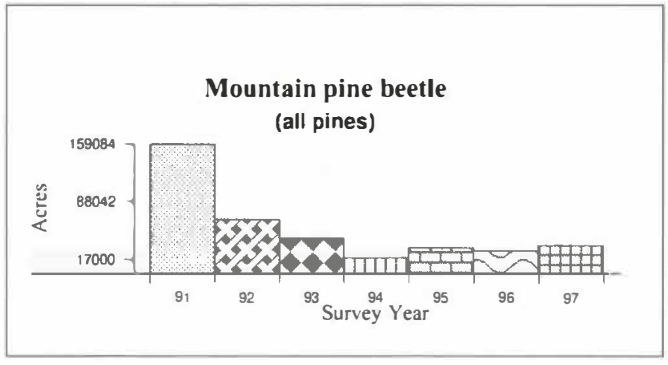
as experienced by other such high-elevation stands in the southwestern part of the state. The most significant groups of ESB-caused damage was noted in the Soda Butte Creek drainage, specifically the Tongue Creek and Pebble Creek tributaries. DFB-infested stands were more prevalent near Hornady Creek, Druid Creek and west of Mount Morris. In addition, numerous scattered groups DF-killed trees were observed in Yellowstone Canyon near Shallow Creek and Deep Creek. At higher elevations, also near Yellowstone Canyon, the affects of WBBB populations were frequent as well.

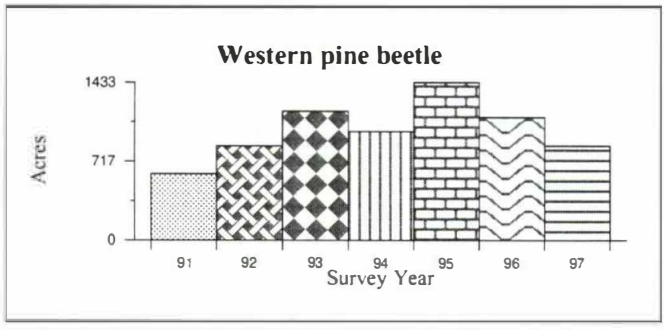
In the northwest portion of the Park, in the Gallatin Range, large areas of SAF killed by WBBB were mapped. Similar mortality was also observed along the north and west boundary of the Park, from Tom Miner Basin, south nearly to Hebgen Lake. Finally, there was considerable WBBB-caused mortality east of Yellowstone Lake--from Columbia Creek to Beaverdam Creek. Scattered at higher elevations in that general part of the Park, MPB-killed WBP was noted. Some of that mortality was associated with WPBR. WBP being affected by MPB, WPBR, or both, was also seen in the southeast portion of the Park, west of Yellowstone River. The southwestern portion of the Park was not flown in 1997.

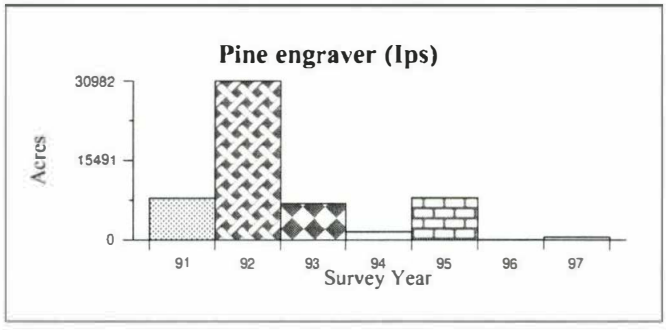
In the part of the Park which was flown, more than 9,200 DFB-killed DF were recorded on about 1,900 acres; 600 ES were killed on 400 acres; slightly more that 1,000 trees (both LPP and WBP) were killed by MPB on 450 acres; and nearly 36,000 SAF were killed by WBBB on almost 13,900 acres.

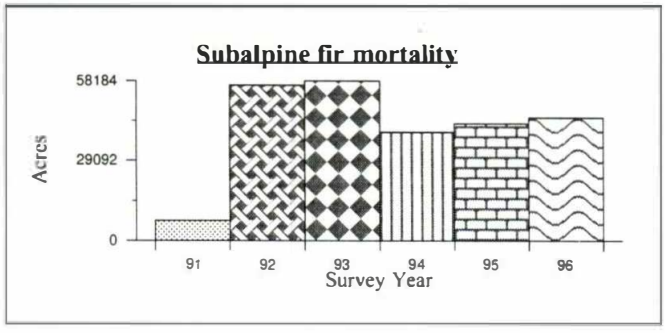
Figure 2. Bark Beetle Infestation Acres and Subalpine Fir Mortality Recorded During Aerial Surveys











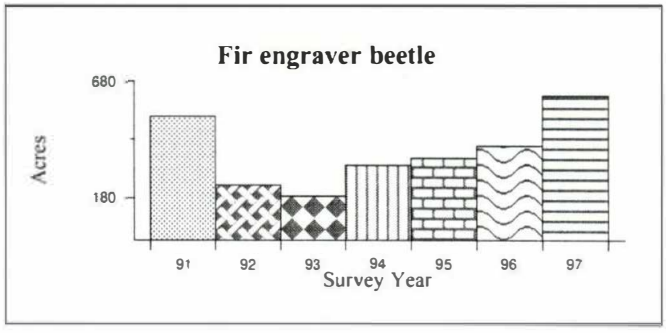


Table 2. Douglas-fir beetle-infested acres in Montana, all ownerships, from 1995 through 1997.

	1995			1996			1997		
Reporting Area	Acres	Trees	Vol. (MBF)[1]	Acres	Trees	Vol. (MBF)	Acres	Trees	Vol. (MBF)
Beaverhead NF	6	8	1.6	31	60	12.0	104	118	23.6
Bitterroot NF	64	121	36.3	145	121	36.3	102	292	87.6
Custer NF	102	256	51.2	663	456	91.2	60	162	32.4
Deerlodge NF	19	21	4.2	40	69	13.8	51	148	29.6
Flathead NF	757	1,840	552.0	535	1,353	405.9	531	1,264	379.2
Gallatin NF	224	502	100.4	737	1,612	322.4	212	602	120.4
Helena NF	1,421	1,082	216.4	322	636	127.2	269	649	129.8
Kootenai NF	554	1,434	430.2	321	797	239.1	390	765	229.5
Lewis & Clark NF	94	35	7.0	29	222	44.4	213	310	62.0
Lolo NF	445	622	186.6	922	1,819	545.7	1,066	1,942	582.6
Garnets	79	116	34.8	125	325	65.0	86	141	28.2
Flathead IR	95	156	46.8	197	118	35.4	183	317	95.1
Crow IR	8	10	2.0	9	11	2.2	4	5	1.0
Glacier NP	1,371	1,877	563.1	64	203	60.9	136	362	108.6
Yellowstone NP	549	880	176.1	*[2]	*	---	537	1,577	315.4
Other	---	---		13	11	2.2	10	9	1.8
TOTAL	5,798	8960	2,408.7	4,353	7,813	2003.7	3,995	8,663	2,226.8

[1]MBF = 1,000 board ft

[2]*Not flown

Table 3. Acres of mountain pine beetle-caused mortality on state and private lands in Montana from 1995 through 1997.

	1995				1996				1997			
Reporting Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	15	2	0	0	2	0	0	0	4		0	0
Bitterroot NF	14	428	0	0	0	291	0	0	0	1,827	0	0
Custer NF	2	42	0	0	4	4	0	0	6	77	0	0
Deerlodge NF	25	21	0	0	25	66	0	0	26	12	0	0
Flathead NF	278	463	2	340	104	10	0	139	46	97	0	158
Gallatin NF	2	0	17	0	119	13	0	0	517	34	10	0
Helena NF	143	290	15	0	39	179	6	0	73	312	12	0
Kootenai NF	416	109	0	60	90	34	0	34	72	16	2	51
Lewis & Clark NF	11	389	0	0	89	953	7	0	147	3,047	0	0
Lolo NF	1,931	1,114	7	0	1,302	922	0	14	2008	1,126	13	19
Garnets	17	374	0	0	12	2,029	0	0	22	629	0	0
Crow IR	*[2]	*	*	*	0	48	0	0	0	4	0	0
Fort Belknap IR	*	*	*	*	0	17	0	0	0	169	0	0
No. Cheyenne IR	*	*	*	*	0	0	2	0	0	4	0	0
Rocky Boy IR	*	*	*	*	0	60	29	0	142	22	0	0
Flathead IR	*	*	*	*	0	466	0	0	29	124	0	0
Other	42	338	0	0	0	0	0	0	0	0	0	2
Total	2,896	3,570	41	400	1,786	5,092	44	187	3,092	7,500	37	228

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

[2]Not flown

Table 4. Acres of mountain pine beetle-caused mortality on Federal ownership in Montana from 1995 through 1997.

	1995				1996				1997			
Reporting Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	65	2	21	0	46	0	12	0	125	4	10	0
Bitterroot NF	37	366	0	0	48	340	0	0	18	463	0	0
Custer NF	0	266	0	0	1	0	6	0	60	447	9	0
Deerlodge NF	109	4	0	0	137	82	8	0	86	14	6	0
Flathead NF	1,729	78	21	479	965	6	31	224	793	24	26	213
Gallatin NF	20	0	118	0	134	0	99	0	304	24	85	0
Helena NF	508	221	58	0	126	216	25	0	144	160	54	0
Kootenai NF	2,941	121	8	1,002	372	53	2	378	663	42	4	429
Lewis & Clark NF	120	488	7	0	558	585	11	0	443	1,047	6	0
Lolo NF	11,465	1,836	27	152	11,629	1,487	7	178	12,766	1,525	34	219
Crow IR	0	8	0	0	2	101	0	0	6	8	0	0
Fort Belknap IR	★[2]	★	★	★	86	1,045	0	0	107	1,129	0	0
Flathead IR	582	593	0	0	507	323	0	0	693	306	0	0
No. Cheyenne IR	0	210	0	0	0	0	0	0		587	0	0
Rocky Boy IR	20	8	0	0	58	46	0	0	60	60	0	0
BLM (Garnets)	0	44	0	0	32	28	0	0	6	47	2	0
Glacier NP	55	2	2	537	24	0	0	60	14	0	0	16
Yellowstone NP	15	0	0	23	★	★	★	★	20	0	22	0
Total	18,268	5,066	262	2,193	15,678	5,827	201	840	16,308	5,887	258	877

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

[2] ★ = Not flown

Table 5. Bark beetle infested acres (other than mountain pine beetle and Douglas-fir beetle) in Montana.

	Englemann Spruce Beetle			Pine Engraver Beetle			Western Pine Beetle			Fir Engraver Beetle			Western Balsam Bark Beetle		
Reporting Area	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997
Beaverhead NF	---	2	14	0	0	156	---	---	118	---	---	0	18,381	18,359	6,081[1]
Bitterroot NF	2	6	6	156	0	0	212	199	0	14	0	0	42	30	12
Custer NF	---	324	0	49	0	33	---	0	0	---	---	0	166	472	434
Deerlodge NF	11	0	3	14	0	0	17	25	8	---	---	0	32	93	61
Flathead NF	76	278	537	36	0	2	94	73	38	61	123	92	415	826	765
Gallatin NF	204	396	299	112	0	60	---	---	0	---	---	0	20,888	24,233	21,251
Helena NF	22	14	8	35	0	0	---	---	106	---	---	0	844	143	111
Kootenai NF	---	4	115	34	0	0	181	128	91	65	29	289	297	50	123
Lewis & Clark NF	11	8	2	637	0	32	---	---	0	192	---	0	235	282	430
Lolo NF	11	129	38	2,896	0	157	2,018	529	314	0	215	215	207	133	161
Garnets	---	0	0	549	0	0	137	0	45	17	0	0	8	4	12
Flathead IR	---	2	2	1,983	0	6	102	159	136	---	31	18	34	16	13
No. Cheyenne IR	4	0	0	231	0	65	---	---	0	0	---	0	★	0	0
Fort Belknap IR	★[2]	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Rocky Boy IR	★	0	0	★	2	0	★	0	0	★	0	0	★	0	0
Crow IR	★	0	0	★	10	0	★	---	0	★	0	0	★	35	0
Glacier NP	★	103	342	★	0	0	★	2	2	★	2	2	★	6	0
Yellowstone NP	★	★	136	★	0	0	★	★	0	★	---	0	★	★	634
Total	249	1,266	1,502	6,732	12	513	743	1,115	857	349	400	615	41,549	41,549	30,088

[1] = Only a portion of the Beaverhead NF was flown in 1997

[2] ★ = Not flown

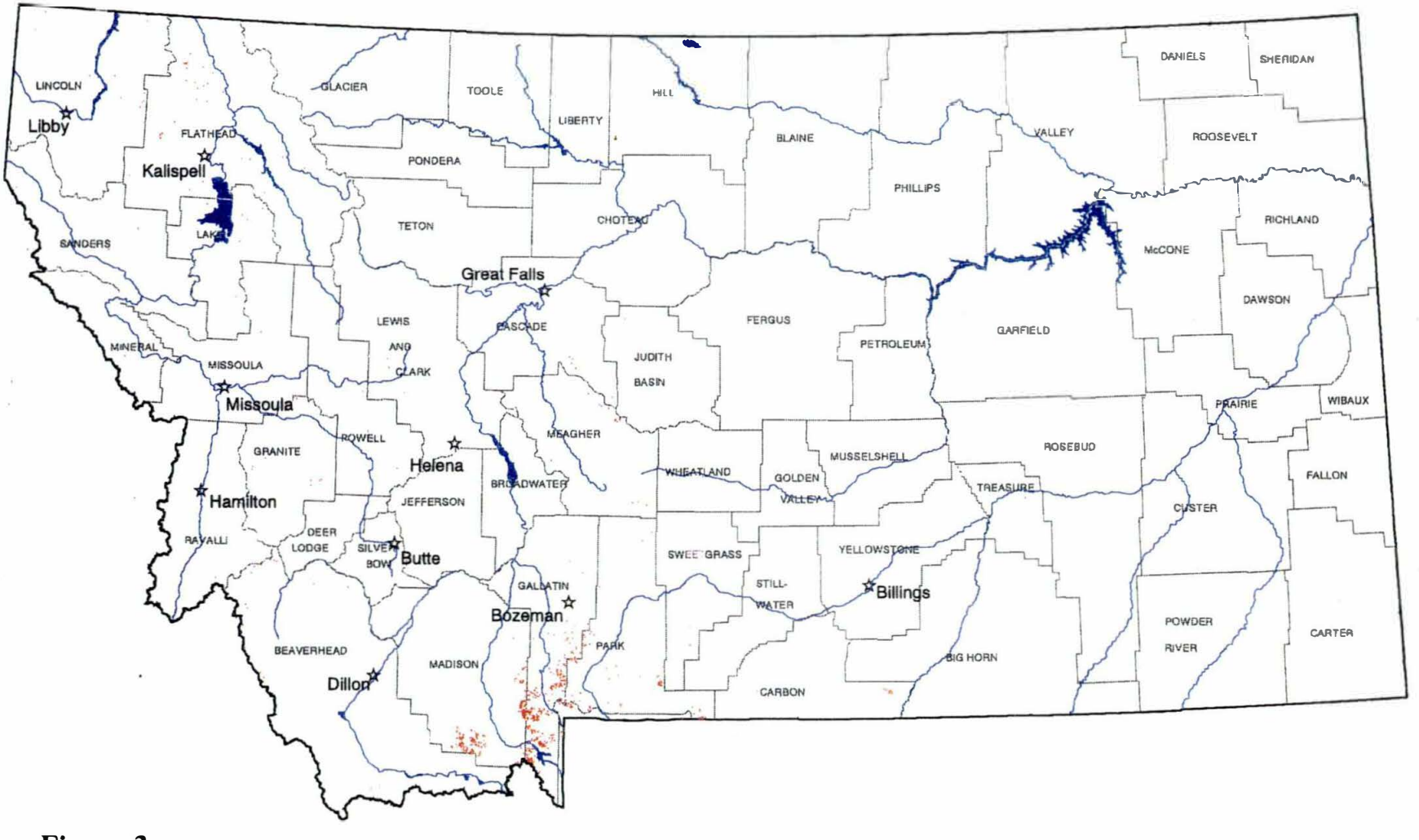


Figure 3.

Areas of subapline fir mortality caused by western balsam bark beetle and other agents in Montana, 1997

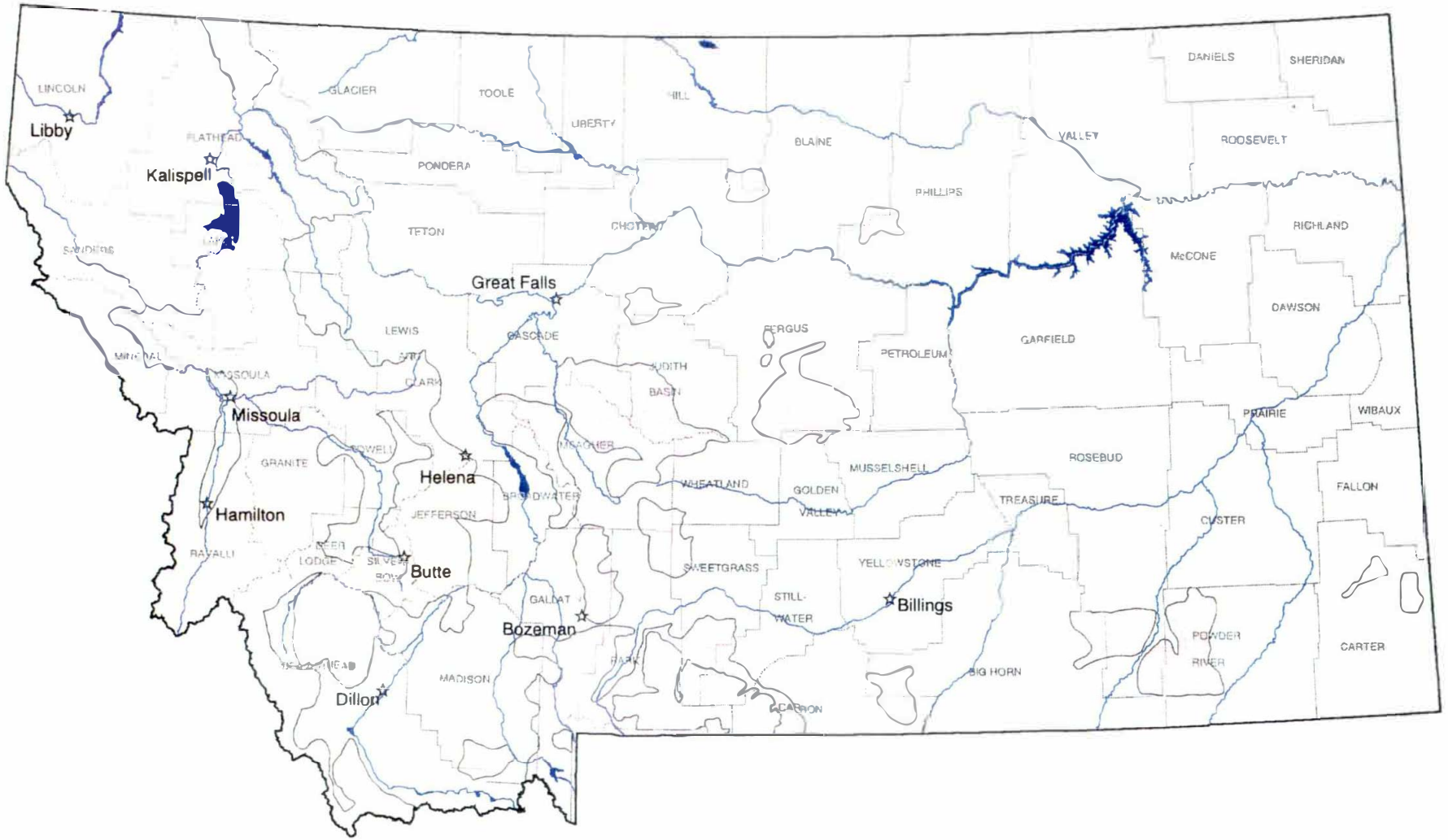


Figure 4.

Areas of 1997 coverage during the Forest Health Protection Aerial Detection Survey in Montana

DEFOLIATORS

Western Spruce Budworm

Western spruce budworm populations remained very low in Montana in 1997. No defoliation was detected from aerial surveys. Very light defoliation was recorded on spruce budworm permanent plots on the Helena and Deerlodge NFs. Two hundred sixty-five male moths were caught in pheromone traps on permanent plots on the Helena and Deerlodge NFs. Spruce budworm populations are expected to slowly build up over the next several years. The population increase will depend largely on climatic conditions and other factors.

Douglas-fir Tussock Moth

Populations remained at low levels, as determined by 1997 results of pheromone-baited sticky traps. Only 8 moths were caught in a total of 165 traps placed at 33 locations. Plots where moths were caught were as follows: Lolo Creek (1); Corral Creek west of Frenchtown (2); Petty Creek near Alberton (1); Pistol Creek (2) and St. Mary Lake (1) both near St. Ignatius; Rocky Pint near Polson (1). No visible defoliation was detected on any forest, but three ornamental blue spruce were severely defoliated in Kalispell.

Gypsy Moth

To try to confirm the possible establishment and better to define the location and extent of any populations in Missoula, an intensive survey using sticky traps was conducted in 1997. This effort was a follow up of 1996 trapping where six moths were caught in Missoula. The 1997 trapping covered a 16-square-mile area which included most of Missoula. A total of 287 traps were placed on quarter-mile grids in a cooperative project by five agencies: Montana Dept. of Agriculture, Missoula Parks and Recreation, USDA Animal and Plant Health Inspection Service, USDA Forest Service, Montana Department of Natural Resources and Conservation. No moths were caught in any of the traps.

Moths were trapped in neighboring states. Wyoming reported six moths, North Dakota caught one moth; South Dakota and Idaho did not trap any moths in 1997. As neighboring states continue to detect gypsy moths and as Asian/European hybrids are introduced to the Region, the importance of detection trapping increases. Thanks to those who participate in this annual program, we are able to assess the threat that the Asian and European gypsy moths pose to Montana's natural resources.

Larch Casebearer

In 1997, visible larch casebearer defoliation occurred in many isolated pockets throughout northern Idaho and western Montana. Heavy defoliation did not occur over large enough areas to be detected by aerial surveys; however, more defoliation was witnessed during 1997 than in the past several years. Surveys conducted this summer show rather low parasitism rates in larch casebearer populations (from 3-13 percent; in the 1970's parasitism rates of 40-65 percent were reported); and population surveys indicate that some areas may have moderate to heavy defoliation in 1998. Monitoring of population levels and parasitism rates will continue into 1998.

Other Defoliators

Satin Moth defoliated cottonwood and willows in the Racetrack, Galen and Warm Springs areas. Defoliation was fairly complete on cottonwoods at the Galen State Hospital. Elm leaf beetle, box elder tortrix, forest tent caterpillar all caused significant defoliation of urban trees in many areas of Missoula.

DISEASES

Most Important Diseases

Annosus Root Disease	Ponderosa Pine Douglas-fir Subalpine fir Other Conifers	Common in ponderosa pine stands west of the Continental Divide; especially severe on the Flathead Indian Reservation.
Armillaria Root Disease	Douglas-fir Grand Fir Other Conifers	Widely distributed, especially west of the Continental Divide. This is the most damaging root disease in western Montana. Infected trees are often attacked by bark beetles.
Laminated Root Rot	Douglas-fir Grand Fir Other Conifers	Occurs throughout the range of Grand fir in northwestern Montana and is known to be particularly damaging on the Lolo and Kootenai National Forests. Infected Douglas-fir and grand fir are often attacked by bark beetles.
Dwarf Mistletoe	Lodgepole Pine Douglas-fir Western Larch	Dwarf mistletoes are widespread throughout the state and one of the leading causes of forest growth loss. Dwarf mistletoe-caused growth losses are estimated at about 33 MM ft^3/year. Lodgepole pine mistletoe occurs throughout the range of lodgepole pine. Douglas-fir mistletoe is scattered throughout the range of Douglas-fir west of a north-south line roughly 25 miles east of Missoula. Western larch dwarf mistletoe occurs throughout the range of western larch in western Montana.
White Pine Blister Rust	Western White Pine Whitebark Pine	Precludes the management of wild western white pine on all but low hazard sites throughout the range of western white pine. Rust resistant white pine has been successfully established on the Lolo, Kootenai, and Flathead National Forests. White pine blister rust occurs throughout the range of whitebark pine causing severe mortality in localized areas and a reduction in cone production.
Pini Rot	Western Larch Pines Douglas-fir True Firs Spruce	Serious decay problem in mature conifers. May also occur at high levels in younger trees. Most important hosts are western larch and ponderosa pine.

DISEASES OF LOCAL IMPORTANCE

Stem And Branch Diseases

Aspen Canker and Trunk Rot	Aspen	Common in most aspen stands in Montana particularly east of the Continental Divide.
Atropellis Canker	Lodgepole Pine	Found in pockets in pole-sized stands causing defect and some mortality. Localized heavy infections are known to occur in western Montana.
Comandra Rust	Lodgepole Pine Ponderosa Pine	Causes growth loss, deformity, top kill and mortality. Especially severe in lodgepole pine in south-central Montana.
Cytospora Canker	Subalpine Fir Douglas-fir Grand Fir	Occurs throughout the range of hosts. Causes branch flagging in large trees and dead tops and mortality in seedlings and saplings. Large trees may be predisposed to bark beetle attack or killed directly following drought stress.
Diplodia Blight	Ponderosa Pine	Causes stunting and mortality of new shoots. Serious infections may lead to death of the tree in association with bark beetle attack. Diplodia is scattered throughout Montana and is locally severe at several locations.
Indian Paint Fungus	Grand Fir Western Hemlock	Occurs throughout the range of hosts. This fungus is the major cause of defect in mature true fir and hemlock in western Montana.
Stalactiform Rust	Lodgepole Pine	Causes growth loss and occasional mortality. Found throughout the range of lodgepole pine and is severe in localized areas.
Western Gall Rust	Lodgepole Pine Ponderosa Pine	Causes stem and branch galls and mortality in small trees. Occurs throughout range of hosts. Infection levels are highly variable.

Root Diseases

Black Stain	Douglas-fir Lodgepole Pine Ponderosa Pine	Confirmed in relatively few locations in the state, all of which are west of the Continental Divide.
Brown Cubical Root and Butt Rot	Douglas-fir Other conifers	Occurs throughout the range of hosts. Causes extensive root and butt rot; especially damaging in stands more than 80 years old.

Foliage Diseases

Elytroderma Needle Disease	Ponderosa Pine	Fungus infects the needles, twigs, and branches and causes brooming. Severe, chronic infections can cause deformation and occasional death of small trees. Known to be locally severe in the Bitterroot Valley and around Flathead Lake.
Larch Needle Blight and Needle Cast	Western Larch	Occur through the range of western larch. Severe infections in successive years may cause growth loss in large trees and mortality in seedlings.
Rhabdocline Needle Cast and Swiss Needle Cast'	Douglas-fir	Occur throughout the range of Douglas-fir and are quite common in northwestern Montana. Infected needles are killed and shed. Important in young plantations including tree improvement areas and Christmas tree operations.

SPECIAL PROJECTS

Effects of the Chlorine Spill on Douglas-fir and Ponderosa Pines Near Alberton, MT - 1996

Shortly after the April 11, 1996 Montana Rail Link train derailment just west of Alberton, Montana, we established plots to evaluate the effects of the chemical drift of chlorine from the spill on all size classes of both Douglas-fir and ponderosa pine trees. Two transects were established near the derailment site (ground zero) and two transects were established approximately 4 miles to the northeast and downwind from ground zero.

A total of 187 trees were selected and permanently tagged for this study. During June of 1996, we made our initial measurements of tree species, height, diameter, crown class, crown ratio, growth, age, mortality, and incidence and severity of insects and diseases. Measurements were made using Region One's stand exam guidelines. Measurements were also taken to evaluate the condition of the tree crown: current damage, damage to last year's needles, and total crown damage. Damage was defined as red, missing or defoliated needles. The technique used to evaluate the crowns was adopted and modified from a technique used to evaluate insect defoliation. In October 1996 and 1997 mortality, crown condition, and insect and disease incidence and severity were remeasured. Tree height was also remeasured in 1997.

In 1998, we plan to remeasure the damage to the crowns of all trees. We also plan to remeasure mortality, tree height, and insect and disease incidence and severity. We are in the process of writing a report of our findings and conclusions. For more information about this project contact Nancy Sturdevant (406) 329-3281 or Blakey Lockman (406) 329-3189.

Developing Techniques to Monitor Insects as Agents for Biological Control of Spotted Knapweed, Evaluating Impact and Determining Optimum Site Release Strategies

Beginning in 1997, a study was conducted to evaluate the effects of several "key" biological control agents on spotted knapweed. The objectives were to: 1) develop monitoring techniques to detect the establishment and spread of two root-feeding biological control agents, *Agapeta zogena* and *Cyphocleaonus achates* for spotted knapweed reduction in forested areas, 2) evaluate the impact of these two agents on knapweed populations, and 3) develop a risk-rating system to determine the optimum forest sites for releases of agents, based upon the site and stand characteristics for five of the most promising root and seed head infesting insects. Cooperators on this project include forest and district land managers, County Extension agents and County Weed supervisors, and the Universities of Montana and Massachusetts and Montana State University.

During the 1997 field season, we sampled 67 sites to develop the monitoring tools and the risk-rating system. At each site, 52 roots were collected and examined for larvae of both species. Adults were also surveyed at each site using a visual estimate technique. We also evaluated the impact of the root-feeding insects on knapweed populations at 13 sites. At these sites, we will have both pre- and post-release vegetation density measurements and insect population measurements. All of these sites are on the Lolo NF and Andy Kulla, Resource Forester, provided the pre-release vegetation measurements. During 1998, we will sample an additional 75 sites in both Montana and Idaho to further develop the monitoring tools and the risk-rating system. Many of the new sites will be county releases. We will continue to evaluate the impact of the two root-feeding agents on knapweed at the selected 13 sites. We will also evaluate several new monitoring techniques for the two root-feeding insects.

We are also determining the field infestation rate of three knapweed seed head feeding insects, *Urophora affinis, U. quadrifasciata* and *Metzneria paucipunctella,* from several north Idaho locations, Faragut Sate Park and a Hayden location. This should enable land managers to have more accurate numbers of insects found in a bundle of knapweed stems from these sites for their releases.

A preliminary summary of our 97 findings will be sent to each forest cooperator. A final report will be produced during 98-99 that will summarize our findings and describe the monitoring techniques that we have developed. If you have

an interest or comments on the project please contact Nancy Sturdevant, (406) 3329-3281 or Sandy Kegley, (208) 765-7355.

Limber Pine Decline (Update)

A series of transects were established on the Lewis and Clark NF in 1996 for the purpose of monitoring the limber pine decline situation (see p. 19, Report 96-2). Tree height and diameter, insect and disease incidence and severity and canopy condition were remeasured on all plots in 1997. In 1998, we will conduct a blister rust survey only. After that, plots will be remeasured every 2 years or more, depending on findings from the 1998 measurements. Contact people for this project are Nancy Sturdevant and Jane Taylor, Forest Health Protection, Missoula, MT and Glenda Scott on the Lewis and Clark NF.

Western Spruce budworm Permanent Plots (Update)

Permanent plots on the Beaverhead-Deerlodge , Lewis & Clark, Lolo, Helena and Nez Perce NFs were remeasured for defoliation and budworm population estimates in 1997. Light defoliation was seen in a few stands east of the Continental Divide. Trap catches of adult moths on plots increased from 16 in 1996 to 265 in 1997. Most of the moths trapped were on the Helena NF. In 1998, trees in plots established in 1993 will be remeasured for new height and diameter growth. Any new insects and diseases present will also be recorded.

All permanent plots will be monitored annually for defoliation and damage over the long term for budworm effects on ecosystem structure and function and for model validation. An establishment report will be published in 1998.

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APPENDIX

COMMON AND SCIENTIFIC NAMES

Diseases

Annosum root disease	*Heterobasidion annosum* (Fr.) Bref.	Primary hosts: DF, GF, PP,SAF
Armillaria root disease	*Armillaria ostoyae* (Romagn.) *Herink*	DF, GR, SAF, sapling pines
Atropellis canker	*Atropellis piniphila* (Weir) Lohn. and Cash	LPP
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.) Pat.	DF
Comandra rust	*Cronartium comandra* Peck.	LPP, PP
Diplodia blight	*Sphaeropsis sapinea* (Fr.) Dyko.	PP
Dutch elm disease	*Ceratocystis ulmi* (Buism.)	American elm
Dwarf mistletoes	*Arceuthobium* spp.	LPP, DF, WL
Brown stingy rot	*Echinodontium tinctorium*	GF, WH
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker	PP
Fusarium root rot	*Fusarium oxysporum* Schlect.	DF (Nursery)
Grey mold	*Botrytis cinerea* Pers. Ex Fr.	WL (Nursery)
Larch needle blight	*Hypodermella laricis* Tub.	WL
Larch needle cast	*Meria laricis* Vuill.	WL
Laminated root rot	*Phellinus weirii* (Murr.) Gilb.	DF, GF, WH, SAF
Lodgepole pine needle cast	*Lophodermella concolor* (Dear.) Dark	LPP
Pini rot	*Phellinus pini* (Thore:Fr.) Pilet.	DF, WL, ES, All pines
Sirococcus tip blight	*Sirococcus strobilinus* Preuss	WWP (Nursery)
Swiss needle cast	*Phaeocryptopus gaeumannii* (Rhode)	DF
Western gall rust	*Endocronartium harknessii* (Moore) Hirta.	LPP, PP
White pine blister rust	*Cronartium ribicola* Fisch.	WWP, WBP
Rhabdocline needle cast	*Rhabdocline pseudotsugae* Syd.	DF

Insects

Douglas-fir beetle	*Dendroctonus pseudotsugae* Hopkins	DF
Douglas-fir tussock moth	*Orygia pseudotsugata* (McDunnough)	DF, TF, ES
Gypsy moth	*Lymantria dispar* (Linnaeus)	Most hardwoods
Mountain pine beetle	*Dendroctonus ponderosae* Hopkins	All pines
Pine engraver beetle	*Ips pini* (Say)	PP, LPP
Spruce beetle	*Dendroctonus rufipennis* (Kirby)	ES
Western balsam bark beetle	*Dryocoetes confusis* Swaine	SAF
Western spruce budworm	*Choristoneura occidentalis* Freeman	DF, TF, ES, WI
Western pine beetle	*Dendroctonus brevicomis* LeConte	PP
Fir engraver beetle	*Scolytis ventralis* LeConte	GF, SAF
Lodgepole terminal weevil	*Pissodes terminalis* Hopping	LPP
Balsam woolly adelgis	*Adelges piceae* (Ratzeburg)	SAF, GF
Pine tussock moth	*Dasychira plagiata*	PP
Sawflies	*Neodiprion autumnalis*	PP
Tip moth	*Rhyacionia species*	PP

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LPP = Lodgepole pine; WWP = Western white pine; ES = Engelmann spruce; WH = Western hemlock; WL = Western larch; MH = Most hardwoods; WRC = Western redcedar; WBP = Whitebark pine

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